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Dental Implant

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Abstract: ***Dental implant is a surgical devices which replaces the lost roots of tooth to which an artificial tooth or complete denture can be attached. The success of dental implant treatment depends on careful preoperative planning. In order to accurately plan an implant procedure it's essential to obtain information regarding the volume, quality and quantity of the bone at a potential implant site. Several imaging techniques are currently available for presurgical and postsurgical examination. These may vary from simple two-dimensional views such as panoramic radiographs to more complex views in multiple planes depending on the case and experience of the practitioner. Dental implant can preserve the tooth structure because there is no need for preparation of the tooth as in dental bridge which need tooth preparation to receive the bridge and also no need for clasp that seated on the tooth as abutment for retention as in removable appliance.***

Keywords: Dental implant, osseointegration, imaging, radiograph

1. Introduction

Dental implant is a surgical devices which replaces the lost roots of tooth to which an artificial tooth or complete denture can be attached [1]. The success of dental implant treatment depends on careful preoperative planning. In order to accurately plan an implant procedure it's essential to obtain information regarding the volume, quality and quantity of the bone at a potential implant site. It's also important to determine the relationship of the proposed implant to important anatomical structures such as nerves, vessels, teeth, nasal floor and sinus cavities at the implant site. This information can be obtained with clinical examination and appropriate radiographs [2].

The basis for modern dental implants is a biologic process called **osseointegration** where materials, such as titanium, form an intimate bond to bone. The implant fixture is first placed, so that it is likely to osseointegrate, then a dental prosthesis is added. A variable amount of healing time is required for osseointegration before either the dental prosthetic (a tooth, bridge or denture) is attached to the implant or an abutment is placed which will hold a dental prosthesis [3].
Success or failure of implants depends on the health of the person receiving it, drugs which impact the chances of osseointegration and the health of the tissues in the mouth. The amount of stress that will be put on the implant and fixture during normal function is also evaluated. Planning the position and number of implants is a key to the long-term health of the prosthesis since biomechanical forces created during chewing can be significant. The position of implants is determined by the position and angle of adjacent teeth, lab simulations or by using computed tomography with CAD/CAM simulations and surgical guides called stents. The prerequisites to long-term success of osseointegrated dental implants are healthy bone and gingiva. Since both can atrophy after tooth extraction pre-prosthetic procedures, such as sinus lifts or gingival grafts, are sometimes required to recreate ideal bone and gingiva. The final prosthesis can be either fixed or removable [4, 5].
There are two commonly used periods to assess an implant failure that relates to the time when it occurred: **(1)** early failures or failures during the osseointegration period (usually within the first year after an implant insertion, during the healing period and initial loading), and **(2)** late failures or failures after the osseointegration period (usually about a year after implant insertion, when an osseointegration process is complete and implant function is established). On the basis of literature review, the causes of early implant failures during the osseointegration process include poor quality and quantity of bone and soft tissue [6], patient medical condition [7], unfavorable patient habits (bruxism, heavy long-term smoking, poor oral hygiene, others) [8], inadequate surgical analysis and technique [8, 9], inadequate prosthetic analysis and technique [8, 9], suboptimal implant design and surface characteristics [7], implant position or location [10] and unknown factors.

2. Types of the Implants

1) Endosteal implants: these are surgically implanted directly into the jawbone. Once the surrounding gum tissue has healed, a second surgery is needed to connect a post to the original implant. Finally, an artificial tooth (or teeth) is attached to the post-individually, or grouped on a bridge or denture [11].
2) Subperiosteal implants: these consist of a metal frame that is fitted onto the jawbone just below the gum tissue. As the gums heal, the frame becomes fixed to the jawbone. Posts, which are attached to the frame, protrude through the gums. As with endosteal implants, artificial teeth are then mounted to the posts [11].
3) Transosteal implants: penetrates through the mandible and projects through the oral mucosa covering the edentulous ridge [11].

3. Bone quality and quantity

The term bone quality is commonly used in implant treatment and in reports on implant success and failure. [12] emphasized that bone density **(Bone Mineral Density, BMD)** and bone quality are not synonymous. Bone quality encompasses factors other than bone density such as skeletal size, the architecture and 3-dimensional orientation of the trabeculea, and matrix properties. Bone quality is not only a

matter of mineral content, but also of structure. It has been shown that the quality and quantity of bone available at the implant site are very important local patient factors in determining the success of dental implants [13, 12], sufficient bone density and volume are therefore crucial factors for ensuring implant success [14]. Therefore, it is important to know the bone quantity and quality of the jaws when planning implant treatment.

Several approaches have been introduced to measure jawbones and skeletal bones density. Densitometric measurements of panoramic and periapical radiographs have been used, as have more advanced methods such as Dual Energy X-Ray Absorptiometry (DEXA), CT and CBCT [15].

Bone quantity of jawbone is broken down into five groups from minimal to severe, A- E based on residual jaw shape, different rates of bone resorption following tooth extraction [16]. During all stages of atrophy of the alveolar ridge, characteristic shapes result from the resorptive process.

Misch [17] defined four Bone density groups (D1 to D4) in all regions of the jaws, In **D1 bone type**this bone density exhibits greater strength than any other type Also, greater heat is often generated at the apical portion. D1 bone has fewer blood vessels than the other three types, and therefore it is more dependent on the periosteum for its nutrtion so the capacity of regeneration is impaired. The **D2 bone type**provides excellent implant interface healing, and osseointegration is very predictable. The intrabony blood supply allows bleeding during the osteotomy, which helps control overheating during preparation and is most beneficial for bone implant interface healing. **D3 bone type**is approximtely 50% weaker than those in D2 bone, the bone-implant contact is also less favorable in D3 bone, Theadditive factors can increase the risk of implant failure. **D4 bone type**has very little density and little or no cortical crestal bone, It is the opposite of D1 (dense cortical bone) It is rarely observed in mandible. The bone trabeculae may be up to 10 times weaker than the cortical bone of D1. The bone-implant contact after initial loading is often less than 25%.

4. Diagnostic Imaging in Implant Dentistry

Phase 1: is termed **pre-surgical implant imaging**it involves all of the old and new radiological examination for assessment of the patient and determining the final treatment plan. The objectives of this phase include all necessary surgical and prosthetic information to determine the quality, quantity and angulations of the bone,the relationship of critical structures to the prospective implant site also the presence or absence of a disease at the proposed surgery site [18].

Phase 2: is termed **surgical and intraoperative implant imaging.**The objective is to evaluate the surgical site during and immediately after surgery, evaluate healing and integration phase of the implant surgery and to insure that the position of the abutment and the fabricated prosthesis are correct [18].

Phase 3: termed **postprosthetic implant imaging** it commences just after the implant placement and continues as long as the implant remains in the jaws. the objective of this phase is to evaluate the long-term maintenance of the implant rigid fixation and function, including the crestal bone level around each implant. Also assist in evaluating the implant complex [18].

Several imaging techniques are currently available for presurgical and postsurgical examination [19]. These may vary from simple two-dimensional views such as panoramic radiographs to more complex views in multiple planes depending on the case and experience of the practitioner.

5. Selection of a Radiographic Method

There are a number of basic principles of radiography that should guide the clinician in selecting an appropriate imaging technique [19]:

1) There should be adequate number and type of images to provide the needed anatomic information.
2) The type of imaging technique selected should be able to provide the required information with adequate precision and dimensional accuracy.
3) There must be a way of relating images to the patient anatomy.
4) In whatsoever technique used, the patients X-ray beam and imaging receptor should be positioned to minimize distortion.
5) The imaging information should balance with the radiation dose and financial cost to the patient. The ALARA principle should govern the selection if more than one technique is feasible [18]. The ALARA (As Low as Reasonably Achievable) philosophy recognizes that, no matter how small the radiation dose, some adverse effect may result. Consequently any dose that can be reduced without difficulty, great expense, or inconvenience should be reduced.

6. Imaging Modalities

There are many imaging modalities that have been employed for implant imaging, including devices developed specifically for dental implant imaging. These modalities can be described as either analog or digital and two dimensional or three-dimensional [18].

Analog imaging modalities are the periapical, occlusal, panoramic, lateral cephalometric radiographs which are two dimensional systems that employ X-ray film and/or intensifying screens as the image receptors [18].

Digital imaging include the computed tomography, tuned aperture computed tomography, cone-beam CT, magnetic resonance imaging. These create a three-dimensional image which is described not only by its width, height and pixels, but additionally by its depth and thickness [18].

7. Conclusion

Dental implants are alloplastic materials surgically inserted into the residual bony ridge, primarily as aprosthodontics

foundation. Dental implant technology has undergone dramatic changes in the past few years and has become a significant treatment planning option in restorative dentistry. Dental implant can preserve the tooth structure because there is no need for preparation of the tooth as in dental bridge which need tooth preparation to receive the bridge and also no need for clasp that seated on the tooth as abutment for retention as in removable appliance. But also the dental implant may be failed due to many causes. So the success of the dental implant depend on good treatment plan of the surgeon represented by:

1) The selection of the patients with good oral hygiene and also healthy patients without systemic diseases or drugs that may affect the implant placement.
2) Take appropriate type of radiograph in order to good evaluation of the bone status and to see the position of the vital structures near the implant site.
3) Also should evaluate the amount of stress in the implant site.

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